

Return to Siberia: The 2008 Kotuykan River Expedition

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In the September–October 2007 issue of *The Earth Observer* [Volume 19, Number 4, pp. 13–21] we presented an article entitled “Expedition to Siberia: A Firsthand Account.” In that article we shared excerpts from a blog that chronicled the adventures of a team of scientists from NASA and Russia’s Academy of Science as they embarked on a three-week adventure in the wilds of Siberia in hopes of collecting measurements to validate data from satellites flying 700 km overhead. The same team, plus a couple new participants, headed back to Siberia this past summer and we are now pleased to present the continuation of their story. For more background details on the expedition to Siberia or if you missed the first part of the story, please refer to the previous article. (PDFs of back issues of *The Earth Observer* are available for download at the following URL: eospo.gsfc.nasa.gov/eos_homepage/for_scientists/earth_observer.php.)

Wednesday, July 9
Joanne Howl

To most people, the word Siberia evokes images of a frigid land of extreme cold... and that is certainly true... but Northern Siberia is also a climatic *hot spot*—meaning it is an area that is warming faster than the rest of the planet. In the past 30 years, average temperatures across the region have risen 1–3°C (3–5°F), while the worldwide average increase in that time is about 0.6°C (1°F).

Again, that’s not to say that it’s time to break out the beach blankets. The region remains fiercely cold. The average wintertime low in Khatanga, a small village in Northern Siberia, is -34°F and can drop to -63°F. Yet the warming trend is so rapid here that scientists are curious to watch the effects on the land.

With such dramatic changes afoot, scientists from all over the world are now looking at Siberia. But some scientists, including **Jon Ranson**, Head of the Biospheric Sciences Branch at NASA’s Goddard Space Flight Center and **Slava Kharuk**, Head of the Biological Laboratory of the Sukachev Institute of Forests, have been studying Siberian forests for decades. Starting July 10, 2008, they led a team of American and Russian scientists on a research mission to an extremely remote and harsh section of northernmost central Siberia.

What did these scientists discover? What challenges awaited them? Read the following blog for a peak into their research during an exciting two weeks. [NOTE: The following article is a condensed version of the expedition blog that was originally posted on *The Earth Observatory*; for the full version please visit: earthobservatory.nasa.gov/Features/SiberiaBlog2008/.]

Thursday, July 10

Jon Ranson
From Taymyrskiy Region,
Siberia
8:15 PM local time
[USZ6S] (8:15 AM EDT)

Our trip from the U.S. to Khatanga went very smoothly. There were few delays. All the bags arrived with their respective owners, on time. Our equipment got through customs without comment. Everybody met as we planned, and everyone arrived on time and healthy.

Maybe things were going too well. I guess we needed a little excitement—and we got it today.

Last year we’d loaded the helicopter down pretty heavily with our gear. This year we had two more people and plenty of extra gear to support them, plus we added some heavy “comfort” items, like a generator. We were pretty certain we would not be overweight, but we knew we’d have little room to spare. Or so we believed...

As we were stowing our gear aboard the helicopter, four Russians appeared. They said very little, but threw a bunch of their own gear onboard, then climbed in along side us. Somehow, everyone got squeezed inside and the pilot took off. When we landed, the four hurriedly inflated a boat, grabbed their gear and took off downriver without a backwards glance.

In steady rain, a Russian M-8 helicopter drops the scientists off on the banks of the Kotuykan River in northern Siberia. In the foreground, scientists cover gear with plastic. This is the first campsite of the expedition, and it will not be a soft one. The beach is covered with marble- to microwave-sized stones. **Photo Credit:** Jon Ranson.



Slava later explained that it's a custom for locals to catch rides when they can. Apparently these were Siberian "good old boys," out for a week of fishing. As he talked, we slowly realized that we were missing a bag—a bag that contained truly vital equipment, including our global positioning system (GPS). We figured it must have gone downriver with the fishermen! All hands scurried to get one boat inflated. We launched the craft, Mukhtar leapt in and sped off, hoping to catch up with the fishermen. Fortunately, the fishermen's boat did not have a motor, so he was able to catch the group, retrieve the wayward bag, and return everything back to camp safely.

It was such an odd experience. We have traveled so far and gone to such great expense to get to this truly remote area of the world, and expected to be completely alone. We certainly never expected to have locals vacationing with us! I guess it is a reminder that, no matter where you travel nor how remote the region, you are always in someone's back yard.

It is fantastic to be here. Everyone is excited to get started. We've set up camp on the beach next to this beautiful river. It's just across the river from several dozen Geoscience Laser Altimeter System (GLAS) footprints, so we are perfectly situated.

At their first campsite, the team assembles for a group photo in front of one of the not-yet-inflated rafts. Back row from left to right: Guoqing Sun, Mukhtar Naurzbaev, Slava Kharuk, Jon Ranson, Pasha Oskorbin, and Sergei Im. Front row from left to right: Ross Nelson and Paul Montesano (Nelson and Naurzbaev are new team members for this year's expedition.) **Photo Credit:** Jon Ranson.



[One of the expedition's objectives is to collect ground-truth data for comparison with satellite data from GLAS on the Ice, Clouds, and land Elevation Satellite (ICESat)]. The only hitch is that beaches in this region are stony—no sand at all. Our campsite is filled with stones ranging in size from a marble to a microwave, all mixed together.

We've caught three nice fish this afternoon. It would have been four, but mine slipped away as I was making my way back to shore. We've got about three pounds of meat and our Russian friends have made a large batch of fish soup. That's basically the entire fish cut into chunks and put into water with some flavorings, then boiled over a campfire until it is declared done. Fresh protein is hard to come by out in the Arctic wilderness, so it is wholesome and healthy food.

We have landed in a wonderful area for our studies; the forests surround us. The trees are relatively small and far apart, but they have been extensively measured by the GLAS lidar. We know that the instrument gives us fairly accurate information [about

biomass] farther south, where the trees are larger. We also know that here, where the trees are small, that the measurements are fairly inaccurate. We are not sure why. So to be able to get into these forests, where we know we have difficulties, and make truly accurate measurements is a wonderful opportunity. I think this is going to be a very worthwhile expedition, with plenty of good data to bring home.

Friday, July 11

Jon Ranson

*From Taymyrskiy
Region, Siberia
8:05 PM*

It's been quite an interesting day, starting with a bit of excitement. For some reason I woke up around 5 a.m., curious to take a look outside. What I saw was alarming: the river we camped beside had begun to rise rapidly. It looked like some of our things were about to be swept away. I began pulling some things inland, as I could. Soon Guoqing, always the early riser, came out of his tent to help. Before long we decided we'd better wake up the camp. Together we managed to pull everything up on land and to safety.

When we returned from making measurements around noon, the river had risen again. We estimated it had risen about 1.5-m (5 ft) since I woke up at 5 a.m.! It was rainy here last night, but not that rainy. There must have been really big rains upstream to make such a difference.

We thought the river was finished rising, but in the afternoon Slava and Mukhtar, whose studies kept them near the camp, saw it rising again. They had to stop their work to move our things and raise the camp even higher. Gosh, I'm really glad we didn't come in the "rainy season" this year!

Today there's not much rain, but it is cloudy and cool....probably in the low fifties, but the wind feels cold in this damp weather. Despite the cool and the breeze, there are still enough mosquitoes to go around. We wear head nets and insect repellent and stay covered from head to toe. With that, they are tolerable.

Mosquitoes and dampness notwithstanding, it was a wonderful day for work. We were able to complete a lot of GLAS plot measurements. What we do is go to the center of the GLAS footprint and outline a 10-m (32.8 ft) circle within that *footprint*—the total area the satellite "sees" in a single image. Then we measure every single tree we find within that circle. We do standard forestry measurements, such as diameter at breast height and height of the tree. We also note the species. Then we move out of the circle and measure the tallest trees outside the circle for additional information.

This year we are 3–4° further north than last year. The elevation is different—lower—than last year, too. Compared to the sites we observed last year, there are about one-fourth the number of trees in the same area here.

Life is very harsh up here; there is no doubt about it... but life is also very vigorous and pervasive. Every bit of ground that can support life is covered. There is moss and lichen as well as these small trees. And there are flowers everywhere—flowers of every kind. We're disappointed that there are no blueberries yet; they won't be ready for a few more weeks. But it is a very beautiful time to be in Siberia.

**Saturday, July 12–
Monday, July 14**

Jon Ranson

*From Taymyrskiy
Region, Siberia
9:05 PM*

Since our last entry, we've broken camp twice and spent one day working in the woods on our various studies. It's been an intensely busy time, but not without some unexpected pleasures. Our last camp was a real treat. We chose the site for its proximity to our research areas, but were pleased to find a little wooded area, up an embankment next to the river, with the ground carpeted by moss and lichens. Not many bare rocks at all! It was soft! What a great night's rest.

Because my tent was in the woods and on high ground, I stayed snug and dry, despite being awakened in the middle of the night to the sound of a hard rain. But a few

Today we've stopped at what appears to be the beginning of a canyon. There are a couple of pretty steep hills on each side of the river. We're excited about this, because it gives the U.S. team an opportunity to make measurements on steeper slopes than we have seen this trip. And it gives the Russian team a great place to gather data on the effect of elevation on treelines. It's a good spot, and we'll work it hard tomorrow.

Photo Credit: Jon Ranson.



Yesterday we had a real treat. The sun came out for the afternoon! How wonderful to see that brilliant blue Arctic sky and feel the warmth of sunlight again! But the sunshine was short-lived; it's overcast again. At least we know the sun is really up there trying to shine on us 24 hours each day. I'm sure we'll see it again, soon.

Tuesday, July 15

Jon Ranson

From Taymyrskiy

Region, Siberia

9:30 PM

It was an interesting day here. The morning started bright and beautiful, with no rain, no clouds. I went out with Guoqing, Paul, and Ross to take measurements of the GLAS footprints nearby, which were across the river and on a mountain.

The mountain is typical for the region: the elevation gain isn't huge, but the slope is fairly steep. These mountains, called the Siberian Traps, have flattened tops and are made of basalt. They were created from the eruption of volcanoes in the area about 250 million years ago. That timing coincides with the Permian extinction, when many forms of life died out. The basaltic flows at that time were huge. Some estimate they may have covered up one to four million square miles. It must have been a world-changing event. It certainly changed this part of Siberia, leaving these magnificent mountains behind. [The Permian-Triassic Extinction was the worst mass extinction in Earth's history. Fossils suggest that between 90-96% of all marine species and 70% of all land species died out.]

There were several GLAS lines along the mountainside. The larch trees were all less than 10-m (32.8 ft) tall. We actually saw a few willows, but none big enough to meet the criteria for measurements; they were so small they could be defined as "shrubs," not trees.

Jon Ranson comments on...

...How a Spaceborne Lidar Works...

Let me explain how this all works a bit more. GLAS is a *lidar*—like a *radar*, except it uses laser light instead of radio waves. The ICESat satellite moves along in an orbit up above the Earth and GLAS fires a laser pulse to the Earth at specific intervals. The pulses hit the Earth about every 170 m (558 ft), and some of the energy is scattered back from the surface. GLAS measures the intensity of the return signal, which is called a *waveform*.

Unlike the beam of a flashlight, the laser pulse stays in a narrow beam as it travels from space to the surface of the Earth. The area *illuminated* by the laser pulse—the GLAS footprint—is roughly circular. When we put the shot locations on a map, it's just like a dotted line across the Earth, with each dot representing a footprint and the line representing the path of the satellite overhead.

The return *waveforms* are affected not only by the height of the trees, but also the branches, the underbrush, the ground, and anything else that exists there. We can calculate tree height from the *waveform* data by subtracting the first return (tops of trees) from the last return (ground). We also use these *waveforms* to calculate *biomass*—the amount of plant material present in the area.

...How Trips to the Field Can Help Improve the Accuracy of Future Lidar Measurements...

Siberia isn't at the top of most people's vacation wish list. We come with a purpose in mind... In some areas on Earth, our calculations using GLAS data match closely to what we measure when we are on the ground. But, when we look at the GLAS data from Siberia, what we see are *waveforms* that are characteristic of bare hillsides, not forest. Yet there is forest here. I see it with my own eyes, and we're measuring it.

We hope that measurements like the ones we are taking here in remote Siberia help us to see what's really going on and, thus, do a better job interpreting the GLAS data. We may then be able to interpret the data we have more accurately, so we may recognize these small forests. If not, we can certainly use the data we're gathering to put into our models, so that in the future, we can build an instrument that will measure these areas more accurately.

One of the issues may be that the measurements in this region are most often taken during the winter. ICESat is an ice mission, after all. These larch trees, although conifers, lose their needles in the winter. Without the leaves on the trees, we may get less return signal from the trees, and this may well alter our ability to interpret whether we have sparse forest or bare ground.

A view of the campsite taken from across the Koruykan River. In the background are the flat-topped mountains known as the Siberian Traps. The slope in the foreground is littered with basaltic rocks formed from lava flows about 250 million years ago. The campsite was originally set up next to the riverbank. It is now on high ground; the river dropped about 6.6 ft (2 m) overnight. **Photo Credit:** Jon Ranson.



After this successful start, we found a nice lunch spot near a cliff. We enjoyed the view as we ate our lunch of canned fish and crackers. We were in a great mood and enthusiastic for the rest of the day's work.

As we made our first afternoon measurements, the sky darkened and a sudden thunderstorm moved in. So there we were, at the top of this mountain with thunder and lightening all around us. And the rain pouring down. What could we do? We just kept working.

I should mention something we've seen here that is pretty interesting. The Russians call it a "tree in a skirt." And, with just a little imagination, that's what it looks like. Basically, the top of the tree is the typical sparse-needled shape of the larch as it grows in this extremely harsh climate. Then, lower down, is a lush green growth. The branches are so heavy with needles that they sag down towards the ground. So it looks like a thin woman wearing a heavy green skirt.

A photograph of a tree near the campsite shows a growth pattern that Siberians call a "tree in a skirt." During Siberian winters, the bottom parts of trees can be covered by snow, which protects the branches from damaging winds. **Photo Credit:** Jon Ranson.



This happens because of the winter weather. When it snows, the bottom of the tree is covered up. This blanket of snow is actually very protective, keeping the lower branches safe. The part of the tree that sticks out of the snow is unprotected, so it is buffeted by the winds, which carry ice-crystals that can act like knives as they slice past the tree all winter long. It makes for an interesting-looking tree in summer! And is another testament to how incredibly harsh the conditions are here in the winter.

This campsite is beautiful tonight. The rains have cleared now. We can see downstream, where the river flows between more mountains. There is a fog rising up from the river between those mountains—a wonderful sight! Yes, we are sleeping on rocks again, but I doubt any of us will complain much—we're tired and should sleep well.

**Wednesday, July 16–
Thursday, July 17**

Jon Ranson

*From Taymyrskiy
Region, Siberia*

10:45 PM

This part of Siberia is incredibly beautiful. Our new camp, where we set up on Tuesday, is right where a smaller tributary river flows into the Kotuykan. When we look downriver, we can see the Kotuykan flowing swiftly between the stark mountains. Larch trees grow well on the top of the mountains, so they appear green and soft. The sides of the mountains are a real contrast. They are dark and sheer, made up of crumbling rock. In some places, where the rock is more weather-resistant, there are formations that look like columns and fortresses that jut out of the side of the mountain.

Yesterday started out nice and dry—a pleasant thing, since we had to break camp and move downriver. Just as soon as we got into our boats and began to move, it just poured down on us. We had rain all day, until we prepared to pull to shore. Then the skies began to clear. As we set up our camp, I heard someone tell us to look downriver. A gorgeous, huge rainbow stretched over the river. With the green trees, the dark mountains, the blue river, and the clearing sky as background, the rainbow was an amazing thing to see.

The expedition's camp is on the opposite side of the river from the study sites. The team uses the largest boat on the expedition, which has a 40-horsepower motor, to ferry people and gear. Paul Montesano and Googing Sun have just disembarked at their study site, while Mukhtar Naurzbaev prepares to return the boat to camp for the day. *Photo Credit: Jon Ranson.*



It was nice to have a peaceful day yesterday, because today was much more exciting. From our maps, we knew that we'd have a tough time getting to our GLAS points to do our measurements today. There were a lot of points, but they were on a sheer-sided mountain. We knew this was not going to be a stroll, but a real challenge. We were more right than we imagined!

As usual, our measurement sites were across the river from camp. We asked Mukhtar, who was staying to work with his colleagues on their studies in the mountains on the camp side of the river, to ferry us across. He took us where we asked: near the entry of a small, steep-sided canyon. We believed that near there the mountain's edge would flatten enough to be safely climbable.

**Friday, July 18–
Saturday, July 20**

Jon Ranson

*From Taymyrskiy
Region, Siberia*

11:57 PM

It's midnight at the oasis here. I'm in my tent, surrounded by a hoard of bloodthirsty mosquitoes all waiting for a drink. Lucky for me they are all outside, so they will have to stay thirsty.

This was a travel day [July 20]. Even though we have to tear down and set up the entire camp, we consider travel days "easy" days, because we do get to sit down for a few hours while we're in the boats. We needed to find a large, flat site for tonight

because this will be our last camp. Two days from now we will have a helicopter come pick us up from here.

We found good spots for our tents about 200 meters away and about 10 meters above from the rocky river bank. It's a little climb from the river, where we are cooking, to our tents. But it's worth it. The view of the Kotuy river and sheer cliffs on the other side is spectacular. The ground up here is less rocky and covered with a bit of grass, so it should be comfortable sleeping.

We got into camp early, about 7 p.m. When we got here, Slava said there might be a good fishing spot nearby and thought we should try to catch something for dinner. The spot was good: Slava caught several really nice fish. And I hooked "Bubba."

I hadn't had much luck using the small silver spoons that had netted me so many fish upriver. So I broke out a *muskie-killer*—a lure with giant hooks and a greenish skirt. It was huge and new. A fish store near my home had suggested it; I figured they did it just because it was so expensive!

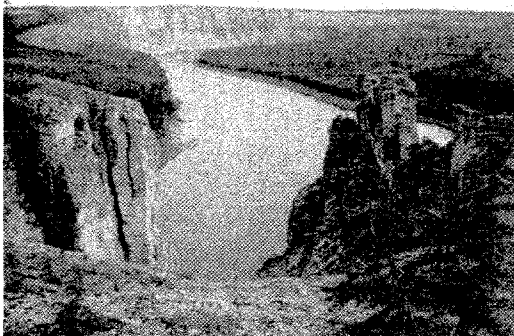
Well, I tossed it about twice, then on the next cast I got a fantastic strike. It was clearly far too much fish for my 10-lb test line, but I managed to play it just fine for quite awhile. Then it leapt from the water and twisted sideways—what a huge fish! Slava thought so too; he said it must've weighed about 20 lbs!

I guess the fish didn't like the way we looked, because when it hit the water it took off straight downstream. My drag was whining as the line went out. I had been teetering on loose rocks on an embankment, while playing the fish, but now I needed to adjust my footing—and I slipped. The rod tip flipped up and I felt the line snap. My giant fish was gone.

Needless to say, I spoke some fine American slang, sitting there on the bank. Also needless to say, fishermen can't walk away when they spot a *Big One*. There are rumors of truly giant fish—taimen over 100 lbs—in the Kotuy River, so mine might have actually been a "Small One!" So we fished until far too late, basking in the sunlight of the Siberian night. I didn't come here to fish, so I can't complain, but it would have been fun to have landed my Siberian "Bubba."

Yesterday we worked in the field. Our measurement sites were at the top of a mountain but we were able to climb up the back side, so no big excitement, just

steady going. We ate our standard sardine, cracker, and candy bar lunch perched on a cliff looking over the river. Just a wonderful sight. It's interesting; we are seeing small patches of snow on the north side of the mountains. It's too warm to snow on us, but too cold for all of the snow to have melted. It may stay here all summer.



We were able, at last, to go from the forest all the way upslope

until we were in tundra. The forest trees became smaller and more sparse very quickly as we gained elevation. The tundra was interesting to see. No trees there, but we did see a lot of caribou skulls and antlers. Some of the guys thought these were fantastic—so fantastic that they carried them all day long and brought them into camp. I'm curious to see if they try to get them on the airplanes going home.

A nice spot for lunch, on the Siberian Traps, that overlooks the Kotuy River. The freeze/thaw cycle cracks and crumbles the rocks. The weather and the river have eroded the mountains into spectacular formations and sheer drop-offs. Photo Credit: Jon Ranson.

Slava has been working hard on several studies. Today was a really good day for him. I think he should have a chance to talk about his side of things.

Slava Kharuk:

We were working today on looking at the effect of changes in climate on the growth of trees. We went up a mountain where there were very old, dead trees. These so-called *fossil trees* are ancient. They died in the 13th or 14th century, in the time of the *Little Ice Age*. Before that, they were growing at the edge of their territory. They were maybe 200 – 400 years old (yet still very small from the hard climate) when the climate got too cold, and they died.

Forest ecologist Slava Kharuk called this a photo of Siberia's "bones and flesh." The "bones" are the skeletons of fossil trees that died prior to the extremely frigid climate of the *Little Ice Age*. Although they died hundreds of years ago, the frigid climate has prevented them from decaying.

The "flesh" is the new trees that are colonizing the area as the climate warms. These trees are growing far above the "fossil" tree line, which is evidence that the current warming trend is very strong. Scientists will use data on the ages of both old and new trees to create a timeline of climate change in this part of Siberia. Photo Credit: Jon Ranson.



These *fossil trees* don't decompose because it is so cold here, but they have fallen over in the last few hundred years. All around them now are younger trees, green and tall. These young trees are evidence that the climate has warmed a lot, so that now conditions will allow trees to grow here again. The young trees are now growing further upslope than the old tree line. That means that this area is warmer now than it was in the warm time before the Little Ice Age.

The climate has changed many times in this area. Once, the climate was much warmer. There were trees growing all the way to the Arctic Sea. But then it got cold and those trees died off. Since then, there have been waves of warmth and waves of cold. **Now we see warming that lets trees grow where they haven't grown for a long, long time. If this warming continues, we may again see trees growing all the way to the Arctic Sea.**

**Monday, July 21–
Tuesday, July 22**

Jon Ranson
From Taymyrskiy
Region, Siberia
9:05 PM

The time is rushing by like lightning. We stay so busy, and the experience is so intense that I can't believe this year's trip is almost over. It seems like we just began a day or two ago. But when I think about my home, my friends, and my family, it seems like forever that I've been gone. On the river it seems almost as if that life is just a dream. But the fact is we're done with the river. And I'm only a half-a-world and four days away from my home.

Yesterday was our last day in the forest. It was a pretty routine day, no special excitement. The weather was cooperative, and the mosquitoes a steady backdrop, just music to measure trees by. We went up the back of the mountain and worked down slope. The trees there were small and far apart. We made a ton of measurements so it was a highly successful, long day's work.

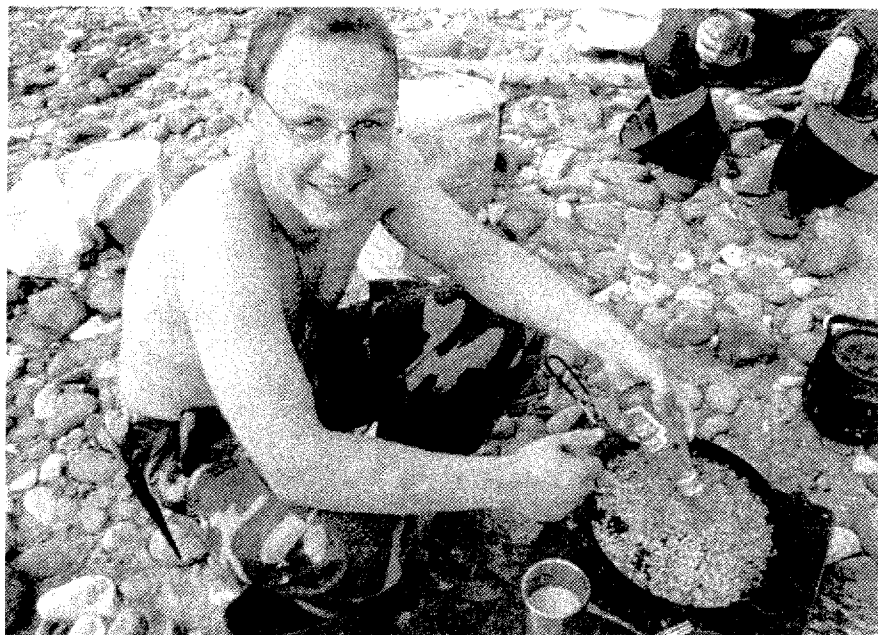
Slava Kharuk (left) and Sergei Im (right) return to camp after a day collecting transects from larch trees. Sergei is holding some of the transects, or cross-sections while Slava holds the chainsaw they used to collect them. These cross-sections will be studied in the laboratory at the Sukachev Institute of Forests. Each one will give the scientists a wealth of information: the age of the tree, climate conditions throughout its lifetime, dates of fires that left scars, and changes of growth rate in response to climate warming. **Photo Credit:** Jon Ranson.



Slava and his team worked the other side of the river. Today they took transects of trees for their fire-return studies. Fire has always been a part of life in the forest. The larch trees actually benefit from smaller fires. The larch resist the heat of fire that burns the underbrush, so a fire will allow the seeds more fertile ground with less competition. And it helps the cones to release their seeds, too. But large and extremely hot fires will damage and often kill larch—so fire is a mixed blessing to this forest.

From his prior work, it appears that fire is occurring much more frequently in recent years, possibly as a consequence of the warming of the region. It also appears that these fires are much larger than in the past, affecting and killing many more trees. To continue these studies, Slava's team cuts slices across the tree and takes these discs back to the lab to analyze. If there has been a fire in the tree's lifetime, it will leave a scar on the tree. Each fire leaves a different scar on a different growth ring. The collected transect of the tree not only can date the fires the tree has lived through, but they are also analyzed to study the effects of the climate on growth and the age of the trees in the forest. So one tree gives a wealth of information for many studies.

Cooking for a team of hard-working scientists in the field is a challenge. Pasha Oskorbin, the primary camp cook, uses his secret ingredient to enhance a meal. He says, "*There is nothing inedible on this expedition. There may just be too little ketchup.*" The label is from an American company, with the brand name written in English. The rest of the label is in Russian Cyrillic: an appropriately international condiment for this American/Russian expedition. **Photo Credit:** Jon Ranson.



The last night in camp was quiet. And yes, fish was on the menu again. We eat a lot of fish here. By this time last year, I was having cravings for borscht, and Paul was constantly reciting a mantra that sounded something like "pizza, pizza, pizza." This year no one is complaining much, although Paul has just begun talking about craving some of his special, secret tacos. I guess we're more satisfied with our diet this year. I'm not sure why. Maybe it's Pasha's secret ingredient—ketchup. He uses a lot of it when he cooks for us.

Early this morning we ate a fast breakfast then hurriedly broke down our tents and boats. We piled our gear near the edge of the flattened area we'd selected as the wilderness helipad. The helicopter was only a couple of hours late—a long time when you are wondering if your ride is really going to show up, but not so long for a connection in the wilderness.

The big MI-8 made a memorable arrival. We crouched down next to our gear, expecting some prop wash to blow on us. We sure got that and more! Apparently the pilot wanted to make it as easy on us to load up, because he came down within five feet of our pile.

Within an hour we were loaded and a few more hours found us in Khatanga. It's a small town, but it seems pretty big now, after coming out of the wilderness. We'll spend two nights here, in a small house that we rented. It's comfortable: no rocks under our beds tonight!

Even though we have soft beds, fresh food, and a roof to sleep under, there's no mistaking that we are still in a different land. This evening I saw a load of caribou meat being trucked to market out of town. The carcasses had been skinned, beheaded, gutted, and frozen. They were piled in the back of a slat-sided, open truck. It was bizarre to see the legs sticking every which-way. Of course, the truck was not refrigerated, other than by natural means. Yes, it's pretty cold here even now—in mid-summer—so I guess they take advantage of the weather. I'm sure it's perfectly safe and edible meat. Still, I think I'm glad I'm not on the receiving end of that load of caribou!

Friday, July 25

Jon Ranson

From Krasnoyarsk

Krai, Siberia

9:10 PM

We're in Krasnoyarsk now—no longer in the wilderness and no longer above the Arctic Circle. This is the third largest city in Siberia, with a population of just over 900,000. To put that in perspective, that's a bit less than the size of the caribou herd in the Taymyrskiy Region.

It's nice to have the amenities that civilization brings, especially being free to make a phone call or hook up to Internet without hanging off the side of a mountain! But there is an adjustment to be made. After our time out camping, I'm finding it hard to get used to a real bed. The first night it felt good to snuggle into a mattress—but I woke up with every muscle in my body aching. I guess my body liked hard rocks better!

Today we'll work at the Sukachev Institute of Forests. I'll have a chance to look at some data and to do some work on a scientific paper with Slava. Then it will be early to bed, and very, very early to rise. Tomorrow, Saturday, we'll begin our journey home. We'll arrive at our home airport on Saturday night. No, that's not just a few hours flight, as it seems. We lose twelve hours coming home, so it's 26 hours of travel.

This has been an exhausting, but rewarding science adventure. The whole team worked very well together, with the Russians and Americans helping each other and enjoying each other's company. The two new members of the team, Ross and Muhktar, became good friends during the two weeks on the river.

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Ross Nelson, Guoqing Sun, and Paul Montesano holding reindeer antlers. They found these antlers on the tundra at the top of a mountain, carried them all day, then brought them back to camp strapped on the bow of the boat. To many Russians, the reindeer is a symbol for wanderers, or nomads—a meaningful souvenir for these three scientists, who have wandered a half-world away from their homes in search of knowledge.

Photo Credit: Jon Ranson.



When we come to the field, we work intensely to gather a lot of very valuable data. **From space, we can gather a huge amount of data to review, but there is always a question of how accurate that data may be under these extreme conditions.** In the field we can touch and measure only a relatively small amount of forest, but it's essential work. This is how we learn to better understand and use our satellites and models—and learn how to improve the instruments, too.

You know, it is really so very, very essential that this *ground work* gets done. Not just for my own studies or for the studies of the members of this expedition. But there is so much to learn, so much that is critical to life on Earth—to our lives and to the lives of generations to come.

I'd really like to emphasize, especially to the younger folks, that **science is a living, exciting, and important career.** Yes, scientists spend a lot of time working with papers and mathematics and meetings in conference rooms. Yeah, if you want to do science, you've got to study hard and make the grade. It's hard work.

But, for those willing to do it, **science offers true adventure**—both intellectually and hands-on. You can explore anything you want, anywhere in the world—or in the universe. And your results can be extremely important. Scientists commonly uncover information that helps us change the way we think about the world. **From time to time, scientists have uncovered information that has literally changed the world.**

I've been asked if I'm coming back to Siberia again next year. Right now, I don't know. We sometimes joke that science expeditions must be sort of like giving birth. I've been told that after such an intense experience that many women swear, right there in the delivery room that they are done, **forever.** But then, soon, they're fantasizing about another new baby.

Right now I'm tired; it's been intense and exhausting. Right now I'm focused on getting home and attending to the new data we've gathered. Right now I just can't imagine going back to that river again. But give me a few months ... or a few weeks. I'll make a bet that I'll be looking over maps and planning the next trip to Siberia before too long. ■